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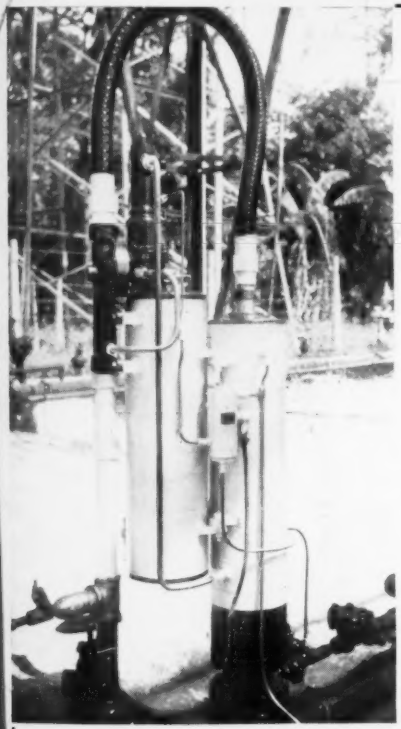

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APPLICATIONS OF RADIOACTIVE ISOTOPES IN THE OIL INDUSTRY

By K. FEARNSIDE

Introduction

Since the construction of atomic piles radioactive materials, which were formerly produced by tedious and expensive refining of naturally occurring minerals, have become available in quantities that are almost unlimited. The use of the expensive naturally-occurring radioactive materials was confined almost entirely to pure research and to therapy, whereas the artificially-produced material from the atomic piles is finding an ever-growing number of uses throughout industry generally.

In the case of the oil industry the use of these materials has been developed in America to a somewhat greater extent than in the United Kingdom. This is due to the facts that radioactive isotopes were available in America three years before they were produced at Harwell and that the production of oil is a major factor in American commerce, whereas in England there is very little oil production and the refining industry is of comparatively recent growth.

In order to understand the way in which radioactive isotopes are used, it is necessary to appreciate a few simple facts of nuclear physics.

Nowadays it is believed that almost the entire mass of an atom is concentrated in the centre of the atom, at the nucleus. The nucleus is an aggregate of particles, some (which are called protons) having a positive charge, and

some (which are called neutrons) being neutral and uncharged. It is found that the chemical behaviour of the atom is governed entirely by the number of protons in the nucleus and is unaffected by the number of neutrons. Atoms which have the same number of protons in their nucleus, and are therefore chemically identical, but have different numbers of neutrons, and so different weights, are known as isotopes of one another. A distinction is made between them by putting the weight after the name of the element. Calcium, for example, has ten known isotopes, six of which are stable and four of which are unstable (q.v.).

The number of neutrons does however affect the nuclear properties of the atom, and if there are too many or too few neutrons compared with the number of protons the atom will be unstable and will emit radiation to reach a stable state. Most materials when placed in an atomic pile will absorb neutrons and so become unstable. In most cases this results in a radioactive form of the original element, but in some cases subsequent nuclear changes produce an element differing from the original one. This can be extracted chemically to produce a pure radioactive element (e.g. P^{32} from sulphur) which is usually described as "carrier free" to denote the absence of inactive isotopes of the radioactive element.

The radiations which are emitted depend only on the radio isotope concerned, and fall into three classes, α, β, and γ radiations. α radiation consists of fast moving helium nuclei, and will not concern us further. β radiation consists of fast moving electrons, which have a range in air of about one metre, depending on their energy, and correspondingly less in denser materials. In passing through matter they collide with, and knock electrons out of the atoms in their path, causing the material to become ionized. γ rays are electromagnetic radiations of the same nature as X-rays but with a shorter wavelength and are only slowly stopped by air or other materials. They too ionize the matter through which they pass, but to a much smaller extent than β rays. Some radio isotopes emit both β and γ radiation, while others emit only β radiation.

The other characteristic of a radio isotope is its half life. This is the time during which the number of unstable atoms originally present decays to half, and varies from a fraction of a second to several thousand years. For practical use, values between a few hours and a few years are normally chosen.

Radio isotopes are detected and measured by the ionizing effect of their radiations. Two instruments are commonly used—the ionization chamber and the Geiger counter. The ionization chamber consists merely of a chamber filled with gas at several atmospheres pressure and having conducting walls and a central electrode insulated from them. A sufficient voltage is applied to the central electrode to ensure that any ions formed in the gas will be collected by it, so that the current in the chamber is proportional to the amount of radiation passing through it. The Geiger counter on the other hand is a chamber filled with a mixture of argon and ethyl alcohol, or other suitable gases, at a pressure about one-eighth of atmospheric. The central electrode takes the form of a very fine wire at a potential of about 1,200 volts positive to the case (see Fig. 1). When an atom is split inside the counter, the resulting electron is violently accelerated towards the centre wire and ionizes more atoms in its path. This means that for each β ray which enters the counter a large burst of electrons strikes the centre

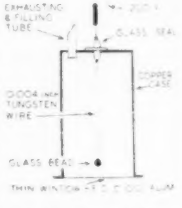

Fig. 1. Geiger Counter

wire. This is in effect an electric current and can be amplified and made to operate a meter, so that each incoming β ray is actually counted.

The fields in which isotopes can be used are conveniently divided into:

(*a*) Production.

(*b*) Chemical research.

(*c*) Research into the properties of oils, in particular, lubrication.

Use in Oil Production

In America a device has been developed for locating oil-bearing strata when trial drilling is being carried out. This consists essentially of a neutron source and a detector which becomes radioactive under the influence of neutrons. The detector is shielded from neutrons coming directly from the source and both together are lowered down the test drill, the activity of the detector being measured and the results conveyed to the surface by electronic means. In dry formations the neutrons emitted by the source are absorbed by the material of which the formation is made and do not activate the detector.

In an oil-bearing stratum, however, the neutrons are scattered by the hydrogen atoms contained in the oil molecules and a certain number of them activate the detector, in the same way as irradiation in a pile would do, with a consequent rise in its radioactivity. The percentage of oil can be measured quite accurately by this means. A similar result will be obtained in water-bearing strata owing to the hydrogen in the water, but a conductivity test is sufficient to show whether oil or water is responsible for the activity.

In the operation of long pipelines, two problems arise in which radioactive materials can help. Firstly, it is often desired to determine when the grade of oil being pumped changes at a point remote from the input to the pipe. This can conveniently be done by injecting a small amount of radioactive material such as barium carbonate into the first few gallons of the new grade of oil. As the oil is pumped along the line, the barium carbonate accompanies it and the location of the barium carbonate can be determined by measurements made with a Geiger counter outside the pipe. Gamma rays from the barium penetrate both oil and pipe with ease so that it is possible to tell when the first of the new grade oil arrives in the required position.

Pipelines have occasionally to be scraped by pumping along them a metallic scraper or "go-devil." Should this stick at any point in the pipe, its location is a matter of some difficulty. If, however, it is made radioactive by inserting into its body a small source of long lived material such as cobalt 60, its location can be determined by means of a Geiger counter outside the pipe in exactly the same way as in the foregoing example.

A different problem which is being tackled by the use of isotopes is the static electricity which is generated when petrol or other organic liquids are pumped through pipes or filters. A very large quantity of electricity is built up under these circumstances and where the bonding between one part of the system and another is not very efficient, a large potential difference will be built up, which may result in sparking and the probability of fire. If the filter or the pipe is lined with suitable radioactive material, the surface layers of the stream of petrol are ionized and the charge which is built up in the liquid can be dissipated as soon as it is formed. Experiments on these lines have been carried out at Harwell and have been successful so far at low pumping speeds under carefully controlled conditions. There is, however, good reason to hope that the method can be turned into one of use for industry generally when more active sources are available.

Chemical Research

In many problems of refining it is desired to follow the behaviour of a given chemical compound when subjected to a chemical process. This can be done by the use of what is called isotope tracer technique. The principle of the technique is that if a compound containing a radioactive atom is added to a chemical system, its chemical behaviour is identical with that of the compound which differs from it only in containing no radioactive atoms, and the proportion of active to inactive compound remains constant throughout the system once equilibrium has been established. It follows that a measurement of the radioactivity in any part of the system shows the concentration there of the compound being studied. Allowance must be made for the decay of the radioactive compound between measurements, and the half life of the active material must be long enough to permit the completion of the experiment in about four half lives.

The advantage of radioactive tracers is that enormous dilutions can be used. Suppose that one millicurie of a beta-emitting isotope is added to a system. This emits 3.7×10^7 beta rays per second and, if one part in 10^7 of this material is present in a sample taken from the system, the sample will emit 3.7 beta rays per second, an amount which can still readily be counted.

The majority of chemical research problems in the oil-refining industry are concerned with hydrocarbons. The tracer method of procedure is ideally suited to the problems which are to be investigated, but unfortunately, the radioactive isotopes of carbon and hydrogen are expensive and difficult to detect. The only carbon isotope readily available is carbon 14, which has a half life of 5,100 years and emits beta radiation of 0.154 MeV maximum unaccompanied by any gamma radiation. It is produced in the form of carbon dioxide or barium carbonate and must then be synthesized into the compound it is desired to study. Certain simple and intermediate organic compounds are now available from the Radiochemical Centre at Amersham, synthesized from carbon 14. Examples are, methyl alcohol, acetic acid, and acetone, but in general, hydrocarbons have to be prepared by the investigator from these simple materials.

The radioactive isotopes of hydrogen, H^3 or tritium, have a half life of eleven years and emit a beta particle of 17 KeV maximum energy unaccompanied by any gamma radiation. In this case the synthesis is a good deal easier as the tritium will exchange with hydrogen in a variety of compounds under the influence of a suitable catalyst at a moderate temperature. From this point of view, it is more suitable than carbon 14 as a labelling material but on the other hand, many of the processes which are to be studied would cause tritium to exchange out again and so its use is limited.

Both substances have the drawback that the beta radiation they emit is very soft and special detection arrangements are necessary. The most satisfactory method is to introduce the active material as a gas into the body of a counter. The counter, therefore, needs refilling with argon-alcohol mixture before each count, and considerable care is needed to keep its characteristics constant. Assuming, however, that a suitable compound has been prepared using one or other of these active materials, the active compound is then added in small amounts to the material whose behaviour it is desired to study. This material is then carried through the process concerned and the amount of activity present at any stage is proportional to the amount of original substance which is present. With suitable detecting instruments amounts down to 10^{-15} grams of active material can be measured with an accuracy of

TABLE I

DETAILS OF SOME RADIOACTIVE ISOTOPES PRODUCED A.E.R.E., HARWELL, OF SPECIAL INTEREST TO THE OIL INDUSTRY

Isotope	*Compound in which perpared*	*Half Life*	*Normal activity per gram.*	*Energy of Radiations (MeV)*	
				(a) *Beta*	(b) *Gamma*
As^{76}	As_2O_3	26.8 hours	250 mC	3.04, 2.49, 1.29	2.15, 1.84, 1.25, 0.57
Ba^{133}	$BaCO_3$	12 days	100 μC	None	1.2, 0.5, 0.26
Br^{82}	NH_4Br	34 hours	50 mC	0.465	1.35, 0.79, 0.55
C^{14}	$BaCO_3$	5700 years	Carrier free	0.154	None
Ca^{45}	$CaCO_3$	180 days	70 μC	0.26	None
Co^{60}	Co metal	5.3 years	10 mC	0.3	1.3, 1.1
Cu^{64}	Cu metal	12.8 hours	100 mC	0.58 (−) 0.63 (+)	1.2
Fe^{59}	Fe metal	47 days	20 μC	0.46, 0.26	1.3, 1.1
Fe^{55}		4 years	20 μC	None	0.006
I^{131}	KI	8 days	Carrier free	0.60	0.367, 0.080
P^{32}	H_3PO_4	14.3 days	Carrier free	1.72	None
S^{35}	Na_2SO_4	87 days	Carrier free	0.170	None
W^{185}	W metal	77 days	2.5 mC	0.69, 0.48	None
W^{187}		24 hours	200 mC	1.4, 0.6	0.86, 0.49

1 per cent, so that extremely small traces can be detected and followed.

The difficulties attendant on carbon 14 and hydrogen 3 do not apply to most elements and chemical research using other active material is a good deal easier in this respect. Table I shows the properties of a number of isotopes which are of interest in this connexion and also from the point of view of production and application problems.

Research into the Properties of Oils, in particular, Lubrication

The tracer technique finds several applications in the study of lubrication problems of which the following two examples are typical.

Firstly it can be used to measure the amount of material transferred under different conditions of lubrication from a slider to a base plate although this may be of the same material. If the slider is made radioactive the amount transferred to the base plate under the conditions of the experiment can be determined by placing a photographic plate on the base plate for a suitable time and developing it, when a blackening will be produced which is proportional to the amount of active material deposited by the slider. Fig. 2 shows three results of this kind obtained under

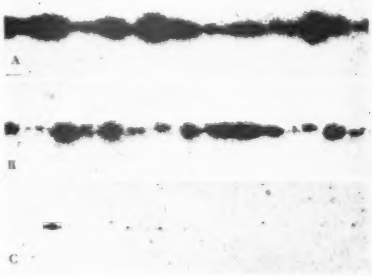

Fig. 2(A). With a clean copper surface, the coefficient of friction was 0.8 and there was a heavy metallic transfer of 10^{-5} g/cm of track.

(B). The surface was lubricated with kerosine (a poor lubricant), and the coefficient of friction was 0.35. Metallic pick-up was reduced to 4×10^{-6} g/cm.

(C). Caproic acid being a good lubricant reduced the coefficient of friction to 0.15 and the metallic transfer to 5×10^{-9} g/cm.

different lubrication conditions in a test carried out by Dr Bowden of the School of Physical Chemistry, Cambridge, and is reproduced by kind permission of Dr Bowden.

Under more practical conditions the method can be used to study the wear of a bearing in a piece of machinery. The bearing is irradiated in the pile and is then placed in the machine and the latter is run under normal test conditions. Samples of oil are removed from the sump at intervals and the activity contained in them is measured. Since this activity can only have come from the irradiated bearing, the method distinguishes between the wear in this particular bearing and in other parts of the machine. In a series of tests carried out by Messrs Hayward Tyler Ltd. on a pump bearing, the wear was determined down to a rate of less than four-thousandths of an inch per year by tests over a period of two hours. It will be seen that results can be obtained much more quickly than by classical methods and also the rate at which the wear takes place can be determined for different stages in the life of the bearing.

Although the use of radioactive isotopes can confer more benefits, it is advisable to be aware before starting an experiment of the possible difficulties and of the health hazards which may be involved. The Isotope Division of the Atomic Energy Research Establishment at Harwell maintains an Advisory Service for the benefit of companies interested in the use of radioactive isotopes and anyone contemplating doing experiments of this type for the first time, should apply there for advice before proceeding.

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WORLD PETROLEUM CONGRESS COMMITTEE OF HONOUR

A committee of honour is now being formed in connexion with the Third World Petroleum Congress, to be held next year in the Netherlands. The Congress will meet in the Kurhaus, Scheveningen, from May 28 to June 6, 1951.

The Organizing Committee has addressed invitations to Dutch statesmen and leading figures in the petroleum industry, and to prominent international figures in the petroleum industry.

A number of Cabinet Ministers, including the Netherlands Ministers for Foreign Affairs, Economic Affairs and Education, and Arts and Science, have already accepted the invitation to sit on this committee of honour.

Meanwhile, the Netherlands Government has acceded to the Organizing Committee's request for permission to hold the formal opening session in the Ridderzaal ("Hall of Knights") in The Hague.

Four lectures are to be delivered during the plenary sessions of the Congress by speakers of international repute. The four speakers are :

Prof. J. J. Broeze (Royal Dutch Shell Laboratory, Delft): "Future aspects of the applications of fuels and lubricants."
Prof. C. Hugel (Institut Français du Pétrole): "Recent progrès dans la chimie du pétrole et de ses derives."
Dr. C. M. Lees (Anglo-Iranian Oil Co. Ltd., London) "The oilfields of the Middle East."
E. V. Murphree (President of the Standard Oil Development Co., New York): "Benefits from research to the petroleum industry."

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NEW CANADIAN REFINERY

Imperial Oil Ltd. are to construct a new refinery at East St. Paul, Manitoba, at a cost of $10 million. Capacity will be 10,000 brl/day and crude will be brought from Alberta by a pipeline now being laid from Edmonton to Lake Superior.

THE COUNCIL AND OFFICERS OF THE INSTITUTE 1950-51

C. A. P. Southwell

At the Annual General Meeting on April 20, 1950, the nomination of Mr **C. A. P. Southwell,** M.C., B.Sc., as President of the Institute for the Session 1950-51 was unanimously approved.

Mr C. A. P. Southwell, M.C., B.Sc., is managing director of Kuwait Oil Co. Ltd. and was previously manager of the Fields and Geological Branch of the Anglo-Iranian Oil Co. Ltd. His first post in oil was with Messrs S. Pearson & Sons Ltd., after which he went to Trinidad and subsequently became Petroleum Technologist to the Government of the Island.

He has a wide experience of the petroleum industry and, as Mr Evans said in inducting him into the chair: "It is probably true to say that he has seen with his own eyes as much of the activities of our own industry throughout the world as anyone. His very extensive travels have brought him into close contact with activities in Texas and California, in Trinidad, in Persia and Iraq, and even in Australia and New Guinea. Recently, he has had a very important part to play in the outstanding developments in the Arab state of Kuwait where, in the space of a mere three years, there has been developed what is now the largest single producing oilfield in the world."

Mr Southwell joined the Institute in 1928, became a member of Council in 1936, a vice-president in 1948, and has served on a number of its committees.

Vice-Presidents

At the same meeting the Council nominated M. A. L. Banks, B.Sc., F.R.I.C., E. J. Dunstan, M.Sc., and J. S. Parker, M.A., B.Sc., for re-election as vice-presidents, and the following as new vice-presidents:

F. Morton, Ph.D., F.R.I.C., who, after graduating in the Faculty of Technology at Manchester University in 1930, was a demonstrator in chemical technology at the University until he took his degree in 1936. He then joined Trinidad Leaseholds Ltd. as research chemist in Trinidad and in 1940 was appointed superintendent of research and development. In 1945 he returned to England as chief chemist to the company, a position which he resigned in December 1948 prior to taking up the Readership in Chemical Engineering at Birmingham University in January 1949. In October 1949 he was appointed Professor of Chemical Engineering at the University.

Prof. Morton has been very active in Institute affairs. From 1942 to 1945 he acted as honorary secretary and treasurer to the Trinidad Branch and in

1947 first elected to the Council. Since 1948 he has been chairman of the Research Committee and serves on the Branches, Finance and Publications Committees.

Hugh C. Tett, B.Sc., D.I.C., started with the Anglo-American Oil Co. in 1928, following post-graduate work on tetraethyl lead in the laboratory of the Air Ministry at Imperial College. He was first attached to the Technical Sales Department, where he gained a wide knowledge of the application of petroleum products throughout the U.K. He became manager of his department in 1935 and in 1939 progressed to the International Association as assistant to David A. Shepard, then technical co-ordinator for Jersey Standard in Europe.

During the war Mr Tett was involved in negotiating supplies of 100 octane fuel and he joined missions to the United States in 1941 and 1943. 1945 found him in France and Germany in connexion with the work of the Combined Intelligence Objectives Sub-Committee on which he served as Lieutenant Colonel.

Mr Tett organized in 1947 the Esso Development Company, of which he was appointed the first managing director, a post which he relinquished in March 1949 on taking up his present assignment as general sales manager of "Anglo."

Hugh Tett's name is familiar to members of many of the industry's committees and particularly in the Institute of which he has been a member since 1928, a member of Council since 1937, a vice-president in 1949 and 1948, and chairman of Council in 1948.

Council

As a result of the ballot, seven retiring members of Council were re-elected and three new members were elected to serve. The latter are:

J. G. Hancock, who has been a member of the technical staff of the "Shell" group for over 34 years, Mr Hancock joined the Asiatic Petroleum Co. Ltd. and gained experience at Sandycroft, Portishead, and "Shell," Central Laboratories before going to Lutong refinery in Sarawak. In 1924 he was transferred to Stanlow refinery as refinery supervisor, where he is now technical assistant to the general manager.

Mr Hancock is a member of the committee of the Stanlow Branch, of which he was a founder member and was honorary secretary for three years. He was elected an ex-officio member of Council in 1949 as representative of the Stanlow Branch and has served in the same capacity on the Branches Committee.

E. LeQ. Herbert, B.Sc., F.R.I.C., entered the petroleum industry in 1923 as a chemist with the Anglo-Iranian Oil Company at Llandarcy. Towards the end of 1926 he joined the Mexican Eagle Group and served in Mexico until 1938. His service in Mexico was mainly at Tampico refinery where he rose to

the position of chief chemist and then superintendent, but also included periods in the Technical Department at the Head Office in Mexico City, and also as refinery superintendent at Minatitlan.

He returned home in 1938 and was posted to Shell's refinery at Shell Haven as assistant refinery manager. In 1939 he was appointed assistant to the general manager of "Shell" Refining and Marketing Co. Ltd., Mr J. A. Oriel, and in 1946 was made assistant general manager of that company, a position which he holds at present.

Mr Herbert has been honorary secretary of the Chemical Engineering Group of the Society of Chemical Industry for the past four years.

C. S. Windebank B.Sc., who first joined the petroleum industry in 1937 as technical adviser to the International Association (Petroleum Industry) Ltd., having previously been connected with research and manufacture in the glass industry.

When the Esso Development Company was formed in 1945 Mr Windebank was appointed research manager and in 1949 he became managing director. He has been particularly active as a member of the Standardization Committee and as chairman of Sub-Committee No 5—Engine Tests.

The Council for 1950-1 is as follows:

W. S. Ault, B.A. (chief chemist, Shell Petroleum Co. Ltd.).
V. Biske, B.Sc., F.R.I.C., LL.M. (research chemist, Lobitos Oilfields Ltd.).
C. D. Brewer, M.I.Mech.E. (engineer-in-charge, Research Engine Services Section, Thornton Research Centre, "Shell" Refining and Marketing Co. Ltd.).
E. B. Evans, Ph.D., M.Sc., F.R.I.C. (research co-ordinator, Esso Development Co. Ltd.).
F. L. Garton, M.A., B.Sc. (in charge (acting) of Sales Technical Advisory Dept., Shell Petroleum Co. Ltd.).
H. S. Gibson, C.B.E., M.A., M.I.Mech.E. (managing director, Iraq Petroleum Co. Ltd.).
J. G. Hancock (technical assistant to general manager, Stanlow Refinery, "Shell" Refining and Marketing Co. Ltd.).
E. LeQ. Herbert, B.Sc. (assistant general manager, "Shell" Refining and Marketing Co. Ltd.).
H. Hyams, (section head, Technical Division, Shell Petroleum Co. Ltd.).
J. A. Oriel, C.B.E., M.C., M.A. (general manager, "Shell" Refining and Marketing Co. Ltd.).
H. E. F. Pracy, B.A. (general manager, Trimpell Ltd.).
D. L. Samuel, B.Sc., A.R.I.C. (technical advisor on lubricants, Sales Technical Advisory Dept., Shell Petroleum Co. Ltd.).
G. H. Smith, Ph.D. (chief chemist, Scottish Oils Ltd.).
R. B. Southall (general manager, National Oil Refineries Ltd.).
E. J. Sturgess, B.Sc. (chief engineer, Shell Petroleum Co. Ltd.).
G. H. Thornley, M.Sc. (manager of the Dept. for Technical Information, Messrs C. C. Wakefield and Co. Ltd.).
E. Thornton, B.Sc., F.R.I.C.
H. de Wilde, M.Sc., M.I.Mech.E. (advisory engineer, Shell Petroleum Co. Ltd.).
A. T. Wilford, B.Sc., A.R.I.C. (superintendent of laboratories, London Transport Executive).
C. S. Windebank, B.Sc. (managing director, Esso Development Co. Ltd.).

Ex-Officio Members of Council

The following were elected as *ex-officio* members of Council to represent the branches:

E. J. Horley (South Wales Branch) (technical assistant, National Oil Refineries Ltd.).
N. E. F. Hitchcock (London Branch) (development chemist, Messrs C. C. Wakefield Co. Ltd.).
I. McCallum (Fawley Branch) (manager, Technical Service Dept., Esso Fawley Refinery).
T. W. Ranson (Northern Branch) (managing director, Ranson Grease Co. Ltd.).

A. G. V. Berry (Stanlow Branch) (superintendent of research and development, Lobitos Oilfields Ltd.).
W. M. Stirling (Scottish Branch) (assistant chief electrical engineer, Scottish Oils Ltd.).

HONORARY OFFICERS

G. H. Coxon and **C. Chilvers**, B.Sc., F.R.I.C. were unaminously re-elected as honorary treasurer and honorary secretary respectively.

★ ★ ★

PERSONAL NOTES

C. E. Olmsted of New York, vice-president and director of The Texas Co. and a member of the A.P.I., has been elected a director of the American Standards Association.

R. T. Haslam, F.Inst.Pet., a vice-president and a director of Standard Oil (New Jersey) plans to retire in the autumn and has asked not to be nominated for re-election as a director. Before joining the Standard organization in 1927, Dr Haslam was assistant professor and head of the School of Chemical Engineering Practice at the Massachusetts Institute of Technology. He became a director of Standard Oil Co. (New Jersey) in 1942.

K. Fearnside, who is the author of the article in this issue on radioactive isotopes, has recently left the Atomic Energy Research Establishment at Harwell to join the board of Isotope Developments. This company has been formed to act as consultants in the application of isotopes to existing research organizations or to undertake experiments for the development of process control.

Henry H. Hewetson, president and chairman of Imperial Oil Ltd., Canada, has been designated as nominee for election as a director of Standard Oil Co. (New Jersey).

Dr Frederick Ljungström has been elected an honorary member of the Institution of Mechanical Engineers in recognition of his contribution to the advancement of engineering.

Among his inventions is one for the extraction of oil from shale and this is being discussed at the Oil Shale and Cannel Coal Conference in July.

Walter K. Link, chief geologist, Standard Oil Co. (New Jersey), has been appointed chairman of the Research Committee of the American Association of Petroleum Geologists.

H. Hyams, F.Inst.Pet., Member of Council, has been elected Chairman of the Council of Aslib (Association of Special Libraries and Information Bureaux). He represents both the Shell Petroleum Co. Ltd. and the Institute of Petroleum on Aslib.

J. Skliros, formerly managing director of the Iraq Petroleum Co., was in recognition of his services, recently invested with the Insignia of Commander of the Legion of Honour by the French Ambassador in London.

W. F. Mitchell has been appointed to take charge of Shell Petroleum Co's new department, Chemical Industry Management, which has been formed to administer the company's chemical commercial enterprises throughout the world, outside Canada and the U.S.

The Rev. F. E. J. Foxall-Smedley will be pleased to hear from old friends in the petroleum industry. His address is Pimperne Rectory, Blandford, Dorset.

★ ★ ★

Dravo Piping. Purchase of a large pipe fabricating plant at Marietta, Ohio, was recently announced by the Dravo Corporation of Pittsburgh. The property consists of two manufacturing buildings, storage yards and an office, and comprises 93,000 sq. ft. of floor space.

CALCULATING PETROLEUM RESERVES
A DISCUSSION

By WALLACE E. PRATT

In a postcript to a recent paper on petroleum reserves,[1] G. M. Lees, our distinguished British colleague, gently and a little facetiously, chides A. I. Levorsen on account of his paper, "Estimates of undiscovered petroleum reserves" read before the U.N. Conference on World Resources in August 1949. Levorsen's estimates, Lees believes, are so large as to be "not reasonable." On this point, Lees observes:

> "*Two thirds of Levorsen's total amount is attributed by him (on the authority of Wallace Pratt) to the continental shelves of the world: but this, of course, is based on a fallacy. The continental shelves of a continent are only the extension seaward of the land mass and, if the adjacent dry land is barren of any oil prospects, there can be no expectation from its submerged seaward extension.*"

There may be other readers who will share my feeling that Lees' remark, "the continental shelves of a continent are only the extension seaward of the land mass," involves an over-simplification which ignores significant differences between the land mass of a continent and its submerged seaward extension. One such difference arises from the circumstance that according to the estimates of established authorities,[2] whose competence, I am sure, Lees will not question, some two-thirds of the total volume of marine sedimentary rocks of the earth's crust are concentrated in the "submerged seaward extension" of the continents, whereas the land masses of the continents, with an area five times greater than that of their seaward extensions, contain only one third of the marine sedimentary rocks of the earth. This is a fundamental difference and it is significant because in the marine sedimentary rocks of the earth are entombed the residues of the organic wastes, accumulated throughout geologic time, which, most of us agree, constitute the source of petroleum. The marine sedimentary rocks are the habitat of the earth's petroleum; and the overwhelming bulk of these rocks lie on the continental shelf and the adjacent continental slope—the submerged seaward extension of the land masses of the continents.

The estimated volume of the marine sedimentary rocks of the continental shelves and their seaward margins, the continental slopes, is more than twenty times greater than the volume of these rocks within the borders of the continental United States. We have already discovered more than 60,000 million barrels of oil in the United States—and the end is not yet! "The United States oil discovery experience," as Lees himself has declared, "straddles such a wide range of structural conditions and stratigraphical ages that it is reasonable to apply it to other countries now less extensively explored." Is it then, a fallacy to apply this experience to the continental shelf, in the region of the greatest abundance of the host rocks of petroleum?

The volume of petroleum already discovered in the United States is more than five times greater than the most enthusiastic estimate of the total ultimate petroleum resources of the U.S. made by its foremost authority on the occurrence of petroleum thirty years ago.[3] Apparently it requires a rare kind of vision to comprehend that "the total amount of petroleum in the rocks underlying the surface," as Edward Orton observed as long ago as 1888, "is large beyond computation." Is it as rare, possibly, as the vision of a Levorsen!

References

(1) Lees, G. M. "Calculating petroleum reserves." *I.P. Review*, 1950, **4**, 33-7.
(2) Twenhofel, W. H. *Treatise on Sedimentation*, pp. 860 *et seq.* (Williams and Williams Co. 1932).
(3) White, David. "The unmined supply of petroleum in the United States." Society of Automotive Engineers, February 1919.

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U.K. PETROL RATIONING ENDS

Rationing of petrol in the U.K., which started on September 23, 1939, ended on May 27, 1950.

Announcing this in the House of Commons in reply to a question on May 26, the Minister of Fuel and Power said that the Government had had a proposal from the Standard Oil Co. of New Jersey to the effect that if petrol rationing were abandoned the company were prepared to bring in additional supplies for sterling. The other U.S. company concerned, the California Texas Oil Co., agreed to a similar arrangement and both undertook to spend the sterling so acquired in the sterling area on goods, services, and tankers.

The refinery expansion programme had made better progress than expected and, said the Minister, the British companies were able to give an assurance that they could find the other petrol required from sterling sources.

Howard W. Page, London representative of Standard Oil Co. and a director of Anglo-American Oil Co., told a press conference that it had long been recognized that the provision of petrol for the sterling area was a problem not of supply but of dollars. The Standard Oil Co. and its affiliates had looked into the possibility of purchasing all sorts of equipment, including tankers, in the sterling area and details had been worked out in consultation with the Government.

He anticipated that Standard would spend about 6 million dollars per year in the U.K. This figure was based on their share of the U.K. sales which was about 28.5 per cent. The share of Caltex was about 7 per cent.

Mr Page estimated that derationing would involve an additional 1 million tons per year for the U.K. with an extra 200,000 tons if other countries in the sterling area desired to participate.

The scheme would remain in operation until the new refinery at Fawley was working. This refinery was designed to meet the requirements of Standard Oil Co. and its affiliates throughout Europe.

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FLAME RADIATION

A joint investigation of the factors affecting luminous flame radiation is being made by physicists from France, Holland, and Great Britain. An experimental furnace, made available by the Royal Dutch steel works at Ijmuiden, is being used by the team.

The work is supervised by committees set up in each of the three countries, the British committee's chairman being Prof. O. A. Saunders, Imperial College of Science and Technology, who is chairman of the Heat Transfer Committee of the Mechanical Engineering Research Board of the D.S.I.R.

Any organization or firm wishing for information or desiring to take part in the work should apply to the Secretary, Flame Radiation Research British Committee, c/o B.I.S.R.A., 140 Battersea Park Road, London, S.W.11.

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Sectional Drive Groups. A new 12-page bulletin (L-362) illustrates two and three-section Ideal Type "BL" Sectional drive groups for Type 50 Consolidated rigs. Copies from The National Supply Co., Box 889a, Toledo, Ohio.

Forth Chemicals Ltd., has been formed by British Petroleum Chemicals Ltd. and Monsanto Chemicals Ltd., and will be concerned in the first instance with the manufacture of monomeric styrene.

BIRMINGHAM STUDENTS ANNUAL DINNER

Among those at the dinner were (l to r): *I. McCallum* (Anglo-American Oil Co.); *H. W. Cremer* (Institution of Chemical Engineers); *R. B. Southall* (National Oil Refineries Ltd.); *Prof. F. H. Garner, O.B.E., Sir Ben Lockspeiser; E. J. Dunstan* (Manchester Oil Refinery Ltd.); *E. A. Evans* (Institute of Petroleum); *W. B. Heaton* (Trinidad Leaseholds Ltd.); *Sir Raymond Priestley, M.C.; D.A.C. Dewdney* (Esso Development Co. Ltd.); *J. W. Barrett* (Monsanto Chemicals Ltd.) *Kneeling* (l to r): *H. A. T. Howe; George Sell* (Institute of Petroleum); *Prof. F. Morton, Prof. Stacey G. Ward; B. G. Banks* (Trinidad Leaseholds Ltd.).

Sir Ben Lockspeiser, F.R.S., director of the Department of Scientific and Industrial Research, was guest of honour at the Annual Dinner of the University of Birmingham Chemical Engineering Society and the Student Section of the Institute of Petroleum on March 14.

The toast of "The Department of Scientific and Industrial Research" was proposed by **Sir Raymond Priestley,** M.C., M.A., D.Sc., vice-chancellor of the University, who said that, in the twin fields of higher education and research, he doubted whether any nation could boast an organ of university administration that could hold a candle to the University Grants Committee. In the D.S.I.R. they also had a second friend as efficient and no less benevolent. University graduate research was largely maintained through D.S.I.R. allowances and grants.

Thanks to the generosity of Joseph Lucas Ltd. and of Sir Peter Bennett, they had recently been enabled to start graduate courses in Engineering Production, said Sir Raymond. The University Grants Committee had asked them to do similar work in mechanical and chemical engineering and in metallurgy. In this they would be asking the help of the D.S.I.R. among others as maintainance allowances on a more generous scale would be needed to attract the right men.

Sir Ben Lockspeiser, responding to the toast, said that they should all be proud to be members of a university that was known the world over.

The association of science with government covered a wide field with interests in housing, in food, in all its aspects, in transport, and in many other spheres. In all of these the D.S.I.R. played a large part.

His department, said Sir Ben, had a great interest in seeing that scientific capital was employed to the full in the universities and similar institutions. In no other country did the universities occupy so leading a place as they did in Britain.

Scientific administration must be

Sir Raymond Priestley, M.C., and Sir Ben Lockspeiser

good. In science there was a different problem than in other spheres. A good scientist challenged society and put forward new and original ideas and it was to this aspect that the administration must pay particular attention.

R. B. Southall, superintendent of National Oil Refineries Ltd at Llandarcy, proposing the toast of "The Society," congratulated them on their work. He also referred to the vacation courses, saying how pleased industry was to have the students in their works and factories and to give them some practical experience.

A. T. Howe (chairman), in response, said that the Society owed much to Professors Garner and Morton for their help and interest at all times and to the Institute of Petroleum for its support.

The Society had progressed much since the last dinner. Among other things they had formed a Graduate Section and had produced a magazine. Both were steps forward.

G. A. Lee, in proposing the health of "the Guests" showed how each guest could claim to head the list and decided that, therefore, it would be more fitting to stick to the time-honoured toast of "The guests."

E. J. Dunstan, managing director of Manchester Oil Refinery Ltd. and a vice-president of the Institute, replying for the guests, reminded the students that industry was on the look out for men and not for robots. He urged them to cultivate *le feu sacré*—a spirit of inquisitiveness and a zeal for discovery.

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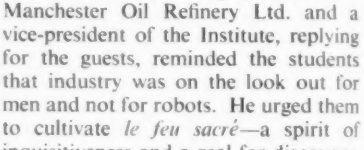
"MULBERRY" OIL DOCK

A thousand-ton pierhead, which saw war service as part of the "Mulberry" harbour used in the Allied invasion of Normandy, has made a 9000-mile journey across the world from Southampton to Banka Straight, Sumatra. Here the pierhead will be used as a loading platform opposite the mouth of the Moesi River, South Sumatra, on which Shell's Platjoe refinery is situated.

Hitherto tankers of 9000 to 12,000 d.w.t. carrying crude oil from Sarawak to the Platjoe refinery, could only take part cargoes, because the Moesi River is too shallow to allow such vessels to pass fully loaded. Now, tankers will make the trip from Sarawak fully loaded to the "Mulberry" pierhead, where a special shallow-draft tanker, ferrying between pierhead and refinery, will take over part of their cargo. It is estimated that the "Mulberry" will enable nearly twice as much crude oil per tanker trip to be carried on the 700 mile-journey from Sarawak to Banka Straight, Sumatra.



Originally used in the Allied invasion of Normandy, this "Mulberry" harbour is doing peacetime service as a loading platform in Sumatra.

The towing of the "Mulberry" from Southampton to Banka Straight was accomplished in a 67-day trip by the Dutch tug *Noord Holland.*

SIGNIFICANCE OF PROPERTIES OF PETROLEUM PRODUCTS

XII. BURNING TESTS

By S. R. HILLS (Fellow)

For illuminating purposes the majority of lamps in use are still of the wick-fed type, although incandescent mantle lamps are becoming more widely employed and may be wick-fed or of pressure vaporizer design. In the latter type the kerosine is pre-heated and the vapour fed to the mantle.

For heating and cooking purposes, wick-fed and pressure burners are also available. The former are of two types, one burning with a yellow flame due to microscopic particles of unburnt carbon in the flame, and the other giving a blue flame. In the pressure type the oil vapour also burns with a blue flame.

The performance of a given kerosine is controlled entirely by the design of the lamp, while the performance of a given kerosine-burning appliance will depend on the quality of the kerosine, in particular on the "burning" quality.

Of all determined properties of petroleum products the burning quality of a kerosine is probably the most arbitrary one, since the effect of the type and design of the equipment designed to burn it, is such that the burning quality can be profoundly modified. It is therefore convenient to consider the burning properties of a kerosine in relation to the three main categories of equipment design.

(*a*) *Wick-fed, Yellow-flame Equipment*

A kerosine of good burning qualities for illuminating purposes in this type of lamp will:—

(i) *burn with a flame of high initial illuminating value or candle-power;*

(ii) *maintain this high initial value during the burning period; i.e. will not choke the wick by causing deposits or char formation;*

(iii) *not give rise to deposits (bloom) on the lamp glass so as to diminish the apparent light value.*

The ability of a kerosine to fulfil one or more of these requirements is a function of its chemical composition, its physical properties, and of impurities in the kerosine, as well as of lamp design and operating conditions.

Initial Candle Power. The initial size and brilliance of a flame depends essentially on the chemical composition of the kerosine in relation to the lamp design. Chemical composition relates to the proportions of the three main types of hydrocarbons classified as paraffins, naphthenes, and aromatics. Whilst the type of crude petroleum from which the kerosine has been derived would normally influence the ratio of hydrocarbon types present, it is possible by suitable refining processes to modify considerably the final composition of the kerosine. The main objective of most refining procedures is to lower the aromatic content whereby, generally speaking, a kerosine of improved illuminating properties is obtained. It is difficult to be dogmatic about the effect of hydrocarbon composition on initial candle power, but it may be stated that essentially paraffinic kerosines give a good flame in lamps of poor draught characteristics whilst, under the same conditions, kerosines rich in naphthenes and especially aromatics burn with a reddish and even smoky flame. In a suitably-designed lamp with good draught characteristics, aromatic-type kerosines can burn brilliantly, whilst the paraffin type may give a low

luminosity flame. Since variations in lamp design, including shape and construction of wick, have such strong effects, it would be quite impossible to standardize a candle-power test which would indicate the relative illuminating power of kerosines in all types of lamps. In special cases where candle-power limits are specified, the particular lamp in which the kerosine is to be burnt is employed for the determination. Lighthouse lamps are a case in point. Here, Trinity House, the controlling body, has its own specification involving candle-power determinations on a standard pressure-fed mantle-type lamp.

There are two main types of yellow-flame wick-fed lamps in general use. One employs a flat wick and the other a circular wick with central draught. It is generally agreed from experience and laboratory data that the former prefers a paraffinic type kerosine, whilst the latter can give a satisfactory performance with the more aromatic types. With the flat-wick burner the candle-power produced is largely dependent on the height of non-smoking flame obtainable and this, in turn, is related to the hydrocarbon composition of the kerosine. As the aromatic content increases, the height of the maximum non-smoking flame tends to decrease. The Smoke Point test, which is described later, was designed to measure this property of a kerosine.

Maintenance of Candle Power. If, after a lamp is lit, nothing occurs to alter the initial conditions then it could be expected that there would be a maintenance of the initial candle power value. In practice, various factors combine to combat this ideal which clearly depends on a maintained constant supply of kerosine to the wick.

As with initial candle power, so with subsequent burning behaviour does lamp design play a significant part. In any lamp not fitted with a constant-level device it is clear that, as the kerosine is consumed, the distance between the surface of the kerosine in the reservoir and the top of the wick increases. The less this distance alters then the better will be the maintenance of kerosine supply to the wick. Practice suggests the conclusion that a large diameter shallow container is preferable to a narrow, deep container.

Another factor influencing the supply of kerosine to the wick is the viscosity of the kerosine. The viscosity becomes of increasing importance as the kerosine level falls and if too high will eventually lead to starvation of the wick and a decreasing flame height. Any attempt to compensate for this decrease by turning up the wick will lead to a temporary correction only, since the increased amount of exposed wick will demand an even greater supply of kerosine.

The remaining important factor is that of char formation, i.e. the black carbonaceous incrustation which forms on the exposed wick as burning proceeds. In amount and appearance it will vary from kerosine to kerosine. Some char is hard and brittle whilst some may be soft. Sometimes it is found uniformly deposited and on other occasions as irregular localized deposits, known as "mushrooms," which distort the flame to a jagged outline. Undue formation of char decreases the flame size and, in extreme cases, extinguishes the flame altogether.

Whilst the chemical and physical properties of a kerosine undoubtedly play an important role in char-forming characteristics, the design of the lamp is a contributory factor. The precise mechanism of char formation is not thoroughly understood, but it does result from breakdown and decomposition of the kerosine at the wick under certain air supply, temperature, and pressure conditions. These conditions will determine the extent of decomposition and whether the decomposition products will remain on the wick or be volatilized. Lamp design

will largely determine these conditions.

In regard to the char-forming characteristics of a kerosine as related to chemical composition, it has been shown that aromatic hydrocarbons are the chief offenders in the type of lamp under consideration. Unsaturated hydrocarbons are also char-forming bodies but are not normally present in illuminating kerosines. It has been claimed that sulphur compounds are char-forming agents but there is no strong evidence to support this.

Inadequate or incomplete refining resulting in the production and retention of undesirable by-products may also cause char-forming tendencies. Relatively small amounts of contaminants such as lubricating oil or certain fatty oils will inevitably increase the char value.

In special applications such as signal, incubator, and brooder lamps, it is essential that a kerosine should give a steady constant flame for long periods without attention. Such equipment obviously demands a kerosine of low char-forming tendencies.

Lamp Glass Deposits. Bloom is the name given to the films or deposits which occur on lamp glasses. Whilst the hydrocarbon-type composition of the kerosine has some effect on its formation, impurities, particularly sulphur compounds, are important factors. Any kerosine burning with a smoky flame will give rise to a brown or black deposit on the glass, and in this connexion a kerosine of high smoke point will allow a greater safety margin between normal operating and maximum flame size.

When the bloom is white, grey, or blue in colour, the primary cause is sulphur. The extent of such bloom formation is however largely dependent on the temperature of the glass, the purity of the atmosphere, and the presence of alkaline bodies on the glass itself. Hot glasses will give less bloom than cooler ones whilst new glasses will lead to greater deposits than old ones which have been cleaned frequently. Of possible atmospheric contaminants, traces of ammonia will emphasize bloom formation.

Wick-fed Blue-flame Appliances

As a generalization it is true to say that these appliances are less susceptible to kerosine burning quality than yellow-flame lamps. Since combustion is more complete, the blue-flame burner will show less differentiation between kerosine types. Nevertheless, a kerosine of low char-forming tendencies in the yellow-flame burner will still have the better performance in a given blue-flame type.

Pressure Vaporizing Appliances

The satisfactory operation of pressure vaporizing appliances can be achieved with a wide range of kerosines, indicating that the properties which are desirable for good performance in wick-fed burners are not so important here. In the vaporizing tube, temperatures of the order of 300°C are encountered and these are generally below the temperatures at which appreciable cracking takes place. Such deposits as are normally found in vaporizing tubes have been found to consist essentially of sulphides of the metals of which the tubes are made. The performance of kerosines in pressure-vaporizing appliances is to some extent related to the presence of particular corrosive sulphur compounds but not necessarily to the total sulphur content of the kerosine. There is no standardized burner for ascertaining the performance of kerosines in this type of appliance and as with lighthouse burners, the individual appliances for which data are required are employed.

Test Methods

It has already been indicated that the burning quality of a kerosine is an extremely arbitrary property dependent

on many factors outside the kerosine itself. Consequently it is frequently necessary to assess kerosine quality by carrying out performance tests in the equipment on which actual data are required.

Certain test procedures have however been found adequate and reliable for classifying kerosines in order of merit, particularly regarding their performance as illuminating oils in wick-fed burners.

Smoke Point Test (*I.P.*—57/48)

This test determines, under carefully controlled conditions in a wick-fed lamp of specified dimensions, the height in millimetres of the maximum non-smoking flame obtainable. Thus, a smoke point of 30 means that under the test conditions the flame may be adjusted to a height of 30 mm before smoking commences.

In carrying out the test the kerosine is introduced into a metal reservoir fitted with a screw top wick guide. This guide is fitted with a piece of round wick thoroughly saturated with the kerosine under test. The reservoir and guide, fitted inside a metal cylinder with a glass door and metal chimney, are carried by a ratchet device which enables the flame to be raised or lowered. To determine the smoke point, the flame is raised until smoking occurs and then carefully lowered until smoking is no longer visible. The height of this flame in mm is read off directly on a suitably placed scale inside the lamp body. All conditions of the test are precisely defined to eliminate as many influencing variables as possible.

I.P. Burning Test (*I.P.*—10/47(T))

The lamp adopted by the I.P. is of extremely simple design and is capable of being manufactured to within fairly close tolerances. It is of robust construction and therefore retains its original dimensions over long periods of continuous use. Being of the flat-wick variety it is reasonably sensitive to kerosine quality. Since this test was first adopted, considerable investigation has been directed towards eliminating all those variables, outside the kerosine itself, which experience has shown to influence char formation. Admittedly the absence of a constant level device, introduces a burning level variation, but the shape and dimensions of the reservoir are such that this level effect is not considered as significant. Avoidable variables which have been fully considered and strictly controlled in this test apart from the mechanical aspects of the reservoir, burner and glass are:—

i. Quantity and temperature of sample.
ii. Construction, quality, shape, size and conditions of wick.
iii. Age and cleanliness of lamp glass.
iv. Temperature and ventilation of test room, including cleanliness of atmosphere.
v. Duration of test.
vi. Initial size and shape of flame in conjunction with strict details concerning initial trimming of wick.
vii. Total and average (per hour) consumption of kerosine.
viii. Removal of the final char from the wick.

A specified volume of kerosine is put into the lamp reservoir and the burner fitted with a new dry wick which has previously been solvent—extracted according to the standardized procedure. This extraction process further standardizes the wick by removing traces of material which would influence char formation. The clean, dry lamp glass which is now fitted is one that has already been "aged" by previous use and acid treatment to overcome the effect of new glasses on bloom formation. The wick is carefully trimmed so that a flame 1 inch high and 1 inch wide is obtained as measured by a special gauge. The lamp is now weighed and allowed to burn for exactly twenty-four hours without interference of any kind, except that at the end of the first hour it is allowable to adjust the flame if necessary to its original dimensions by turning the wick up or down. At the end of the

twenty-four hour period, the lamp is extinguished and re-weighed, and observations on bloom formation recorded. The charred wick end is cut off, washed free from kerosine with a suitable volatile solvent and then dried. To separate the char from this portion of wick, the wick structure is first broken down so that a mixture of black char and wick fibres is obtained. The separation of char particles from wick fibres is effected by hand, and whilst this process is affected by the personal element and experience, it is by no means as difficult as would appear. The weight of dry char so obtained is recorded and reported in terms of milligrams per kilogram of kerosine consumed. This figure is designated the "char value" of the kerosine.

A.S.T.M. Burning Test (*A.S.T.M. D*4187-47(*T*))

The essential difference between the I.P. and A.S.T.M. tests is that the former is quantitative, whilst the latter is qualitative. Otherwise the general procedures are similar. In the A.S.T.M. procedure, the kerosine quality is related to average burning rate, bloom formation, and general appearance of the wick at the end of the test.

Until quite recently, the A.S.T.M. method allowed only the Saybolt lamp and the test procedure differed mainly from that described by the I.P. in that a larger flame and consequently a larger kerosine consumption was employed. As a result of this larger consumption it was necessary to replenish the kerosine supply at eight and sixteen hour intervals. The I.P. lamp and general procedure (excepting char determination) is now allowed as an alternative to the Saybolt lamp.

Long-time Burning Tests (*I.P.* 11/42; *A.S.T.M. D* 219-36)

These tests are more specific in their application than the previously described burning tests in that they are intended for the evaluation of special kerosines used in railway signal and similar lamps. It has been emphasized that lamp design has an important effect on the apparent burning quality of kerosines and the burning test for long-time burning oils is an example of tests utilizing actual lamps in which the oil is to be used. In these tests, the same rigorous control of operating conditions is applied but the burning period, as might be expected, is much longer and covers seven days. At intervals throughout the burning period, observations are made on height of flame, condition of flame, wick and burner, and soot formation. The weight of char formed on the wick is also determined if required.

Interpretation of Test Results

It will be appreciated that both the I.P. and A.S.T.M. test lamps used for evaluating kerosines for use as ordinary illuminants are just representative types of the flat-wick yellow-flame class of lamp. Within this class there will be found wide variations in size, shape, and other detail. Owing to the influence of these variations there can be no claim that the observations of burning performance made on the test lamps will apply absolutely to all commercial lamps, but the tests will and do classify burning oils in order of merit, although the degree of differentiation may be different. For example three kerosines may give char values of 5, 10, and 15 mg/kg respectively in the I.P. test lamp and the corresponding figures in a commercial lamp might be 5, 7, and 11 or 3, 15, and 30. In general it may be stated that of a series of kerosines rated by the standard tests, the best will remain the best and the worst the worst in any lamp of the wick-fed type. According to the lamp design however it may become easier or harder to detect the differences between the best and worst as established in the standard lamp.

The long-time burning oil tests are much more absolute, since actual signal lamps are used in carrying out the test.

Although considerable stress has been laid on the effect of various factors—outside the kerosine itself—on the burning quality of a kerosine and as a result, the inevitable arbitrary nature of burning test results, it should be emphasized that the experience of many years has shown that the tests are invaluable for controlling market quality. Despite the wide range of lamp types and the unpredictable level of user maintenance, which can clearly have considerable influence on kerosine performance, burning test results have been in line with practical performance and it may be concluded therefore that the tests have justified their status as standard methods.

SUGGESTIONS FOR FURTHER READING

"Standard Methods for Testing Petroleum and its products." Institute of Petroleum.
"A.S.T.M. Standards on Petroleum Products and Lubricants."
"Kerosine." J. Kewley and C. L. Gilbert, *The Science of Petroleum*, Oxford Univ. Press, 1938, **4**, 2470-85.
"The burning of mineral oil in wick-fed lamps." J. Kewley and J. S. Jackson *J. Inst. Petrol. Techn.*, 1927, **13**, 3.
"The chemical significance of tendency to smoke." S. T. Minchin. *Proc. World Petrol. Congr.*, 1933, **2**, 738-43
"Luminous stationary flames." S. T. Minchin. *J. Inst. Petrol. Techn.*, 1931, **17**, 102-120.
"The testing of kerosine for illuminating purposes." J. S. Jackson. *Proc. World Petrol. Congr.*, 1933, **2**, 699-702.
"Testing lamp kerosines." B. H. Moerbeek. *Proc. World Petrol. Congr.*, 1933, **2**, 703-5.
"Discoloration of kerosine." B. H. Moerbeek. *Proc. World Petrol. Congr.*, 1933, **2**, 712-6.

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Crank Counterweighted Pumping Units covering A.P.I. walking beam ratings from 20,700 lb to 32,000 lb are described in Bulletin No. 337 issued by The National Supply Co., Box 889a, Toledo, Ohio. This bulletin completes a set of three covering the company's entire range of beam and crank counterweighted pumping units.

PETROLEUM IN PARLIAMENT

Petrol Consumption

In a written answer on April 5 the Minister of Fuel and Power said that though statistics were not available regarding consumption of motor spirit by different classes of consumer, the following estimates might be made by consumption in Great Britain in 1948 and 1949.

	Thousand tons	
	1948	1949
Government Departments	112	95
Services	104	87
Private motorists	1,380	1,500
Industrial, commercial and other consumers ..	2,579	2,885
TOTAL	4,175	4,567

Refinery at Tynemouth

Asked what encouragement was being given to the commercial firm in negotiation with the Tynemouth Corporation for building an oil refinery on Corporation land at South Shields, the Minister of Fuel and Power said in a written answer (April 24) that the proposal was approved in principle in August, 1947. His Department has recently asked the firm when they would start building. The reply was that they would not be able to start this year.

Pool Petrol

Questioned as to whether the quality of pool petrol could not now be improved, in view of the increased price, the Minister of Fuel and Power said, in a written answer (April 24) that he could not at present hold out hope of change, since the supply of a better quality petrol would reduce the total amount of motor spirit produced at sterling refineries.

AROUND THE BRANCHES

FAWLEY, LONDON, NORTHERN, SCOTTISH, SOUTH WALES, STANLOW, TRINIDAD

London Branch

On the evening of 30 March 1950 the chairman of the London Branch A. J. Goodfellow, presided over a well attended meeting which heard a paper by R. B. Southall (member of Council) on *Refining and Processing*, the fifth in the series "Petroleum Today."

Mr Southall devoted the early part of his paper to a brief description of the general characteristics of crude petroleum, followed by an exposition of the principles employed in refining, which could be described as a series of operations in which crude oil is separated into groups of marketable products, and these are then further treated to remove impurities which would be harmful in service. The second part of the paper dealt in considerable detail with processing, defined as the application of the principles of refining, and the equipment used for carrying out the processes; interest was added by a notable collection of coloured slides, beautifully executed, which, with explanation by the lecturer, conveyed a good idea of the many different processes. Throughout his talk, Mr Southall made clear the course of development of the methods and processes he was considering, and then summarized today's major trends in refining generally and in the United Kingdom in particular. Finally Mr Southall referred to the increasing importance of labour relations and the vastly greater degree of technical ability required in all but a small proportion of the workers in a modern refinery. Two films, "Distillation" and "Cracking," rounded off a very instructive and interesting evening.

A vote of thanks to Mr Southall, proposed by F. V. Pedrick, was carried with acclamation.

A Visit to Shellhaven

In Great Britain it is not always easy to relate the theory of refinery operations to their practical accomplishment; but through the courtesy of the "Shell" Refining & Marketing Co. Ltd., the London Branch was able to attempt to overcome this difficulty by arranging to follow up Mr Southall's paper with a visit to Shellhaven refinery.

On Saturday, April 1, a party of thirty members of the Branch went to Shellhaven, some by car and the remainder by coach, in what a cynic might describe as typical "refinery-visit" weather—some sunshine, but also rain, with a searching icy wind. The party was split into three sections, each with its own well-informed guide; the refinery was visited in two halves, and each part was preceded by an explanation with the aid of a flow-chart, which enabled even the most inexperienced to appreciate the situation when the plant itself was seen. The visitors were shown the production of low-viscosity-index industrial lubricating oils, involving acid and fuller's earth treatment, and the manufacture of bitumen, including a very modern blowing unit, as well as the plant producing high-viscosity-index solvent-extracted lubricating oils. The refinery management kindly provided a most enjoyable lunch, and the party left at the end of the afternoon with an enhanced acquaintance with a side of the industry which, although fundamental to the work of us all, is still far too little-known to many oil people, particularly in London.

The Long-Range Picture

The meeting on April 20 of the London Branch opened under the chairmanship of the retiring chairman, A. J. Goodfellow, who introduced Mr C. A. P. Southwell, the new President of the Institute and, after expressing the Branch's appreciation of the honour of the President's presence, offered him the chair, which Mr Southwell gracefully declined. The minutes and notices were read and A. J. Goodfellow then announced his retirement from the chairmanship, which he has held since the inception of the London Branch, and introduced his successor, N. E. F. Hitchcock, in a short speech thanking the officers, the committee and the members for their support and referring to Hitchcock's pioneer work as secretary.

Norman Hitchcock thereupon took the chair, amid much applause, and after thanking the meeting for his welcome, introduced the new officers, R. D. Streeton as vice-chairman, and H. G. Spence as secretary, with J. C. Jewell remaining as treasurer, he gave well-deserved praise to the admirable work of the retiring chairman during the difficult years of the formation and establishment of the Branch and to the energy, charm of manner and tact which he had shown in the discharge of his office. Finally he introduced the evening's speaker, Mr Howard W. Page, of the Standard Oil Company of New Jersey and a war-time divisional director of the Petroleum Administration in Washington, who presented the sixth paper in the series "Petroleum Today"—*The Long Range Picture*.

Mr Page commenced by affirming that the soundest development of the industry would occur under the spur of competition and this would depend on freedom from controls. He then dealt with the changing pattern of world oil movements, pointing out that the Eastern Hemisphere is now almost self-sufficient in oil: he expected that in two years' time there would be a net volume movement of petroleum products from East to West, with a net movement of value of products in the same direction developing in about five years' time. The speaker thought that, as far as the Middle East was concerned the biggest increase would be in supplies from Iraq, as new pipelines came into operation; the present rapid expansion of all fields was in the main due to the change-over from the U.S.A. as a world source of supply and when this was complete, in about three years' time, further expansion would taper off, and follow increases in consumption only. The anticipated scale of replacement of tankers by pipelines had been somewhat reduced, due to the fact that large pipes cost dollars, while large tankers are available for sterling, but competition between the two would continue.

As far as the U.S.A. was concerned, refiners were reducing residual fuel production to the minimum, as natural gas and coal competition looked like keeping this a rather depressed market. Exports of all except certain specialized products, such as lubricating oils, were virtually confined to neighbouring areas. Meanwhile, proven reserves in the United States were now increasing faster than consumption and, in consequence, interest in synthetic oil had decreased.

Finally, Mr Page foresaw that the industry in the Eastern Hemisphere would find its problems differing increasingly from those of the West, so that it would depend less and less on following U.S. practice. Higher living standards would inevitably bring greater demand for oil, a demand which the industry would doubtless meet as efficiently in the future as it had done in the past.

A brisk discussion followed the paper.

Mr Southwell brought the meeting to a close by thanking Mr Page on behalf of all those present for his very interesting paper.

FILMS ON PETROLEUM

Wealth of the World — Oil

An impressive short documentary on the theme of oil's place in the world economy has been produced for Pathé by Peter Baylis. The first of a series under the general title of "Wealth of the World," "Oil" runs for twenty minutes and shows crisply and compactly how we use oil and where we get it from.

Shots of the wheels going round in big cities fade to scenes of European devastation and the commentary explains how, in the rebuilding of Europe's shattered industries, oil is needed in ever-increasing quantities. Australia, vital source of food and wool supplies could not exist for a day without oil, says the commentator, and the film shows a sheep farmer who is all day "in the saddle"—of a motor cycle.

The commentary is pleasantly voiced by several speakers with varying accents —a Western drawl accompanies shots of the U.S. oilfields, a Scot describes the engineering feats which have to be performed to gain Middle East oil, a north-country burr tells of industrial production in Britain and an Australian speaks of his own country.

The "Wealth of the World" series is to be shown at A.B.C. cinemas.

A.I.O.C. Oil Review

Pioneers of documentary films in the 1920's, the Anglo-Iranian Oil Co. has recently introduced a series of ten-minute cinemagazines under the general title of *Oil Review*.

The primary object of *Oil Review* is to provide information to the public and to the 130,000 employees of the A.I.O.C. Group on the wider use of petroleum in the world today. To the staff, it will also serve to indicate the part they play in a closely integrated organization.

It is proposed to produce a new issue every two months, each containing several items of interest connected by the general theme of oil. One, or perhaps two of the items will be concerned with a company activity, while the remaining features will be of a general nature such as agriculture, aviation, transport, etc.

Thus, the first four issues gave a good cross-section of modern activity in petroleum.

No. 1, naturally, opens with a glimpse of the company's operations in Persia, with shots of the Abadan refinery, the fields, the harbour, etc. General interest is provided by the manufacture and trials of No. 10,000, the diesel-electric locomotive in use by British Railways, and by illustrations of modern developments in tractor design.

No. 2 commenced with an account of present methods used in the search for oil. Then there is an interesting description of the manufacture of pipelines for the Middle East from old battleships and some good shots of the De Havilland Comet during manufacture and its trial flight.

No. 3 illustrates the refinery at L'Avera, in Provence, the majority of the shots showing how the personnel are catered for with recreational and other facilities. Then follow some really unique pictures of the launch of the 16,000-ton tanker *British Reliance*, showing the preliminary arrangements needed to ensure a smooth passage and unusual views taken from keel level.

No. 4, after showing the transport of a 96-ft fractionation column from the works to Grangemouth refinery, illustrates the use of petroleum in the rearing of chicks by providing heat for the incubator and for the "foster parent." Then follow fascinating examples of the glass-blowers' art in the manufacture of laboratory fractionation and similar equipment.

Mr R. E. Tritton, who is in charge of A.I.O.C. film production, is to be congratulated on his efforts in inaugurating and fashioning such an interesting series of films. He is busy on future issues and a unit is on location in Persia to cover Middle East activities. The films, which are 16-mm, are being made by Greenpark Productions Ltd. and

are being distributed in the U.K. by Petroleum Films Bureau from whom they may be borrowed free of charge. They are also being circulated, with script in various languages, to all overseas associated companies.

P.F.B. List

Petroleum Films Bureau's 1950 catalogue lists 22 titles in the "Films about petroleum" section, including five additions to the 1949 catalogue. These are Anglo-Iranian's *As Old as the Hills* and *The Unknown Quantity* (the search for oil in Papua) and Shell's *Prospecting for Petroleum, Pattern for Chemicals*, and *New Detergents*.

In addition, the catalogue lists 22 films of general interest, 18 films about aviation and motor cars, including a record of the 1949 S.B.A.C. Show at Farnborough and the Bureau's four road safety films for children.

Applications for the loan of these films should be addressed to the Bureau at 29 New Bond Street, London, W.1.

★ ★ ★

WAR AGAINST SILIÇOSIS

From 1931 to 1945, more than 22,000 workers in British coal mines were certified as suffering from either silicosis or pneumokoniosis caused by the effects of coal dust. Coal dust, too, has long been recognized as a dangerous explosion hazard.

A new system of dust suppression, the addition of very small quantities of a wetting agent to the water used for this purpose in mines, is said to be achieving satisfactory results. For spraying the solution, a device known as the Teepol Injector has been evolved by the Permutit Co., in collaboration with the Shell organization. The use of this injector is described in a booklet "The suppression of dust in coal mines," published by Shell Chemicals Ltd.

A.S.T.M. ANNUAL MEETING

At the 53rd annual meeting of the American Society for Testing Materials, to be held in Atlantic City in the week beginning June 26, a large number of technical reports will be presented and there will be exhibits of testing apparatus and photographs. The 1950 Marburg Lecture is to be given by Dr Wallace R. Brode, associate director of the National Bureau of Standards, whose subject is spectroscopy as allied to testing and analysis of materials.

Among the symposiums scheduled are: "Corrosion and erosion of gas turbine materials," "Non-destructive testing" and "Sigma phase of metals in high temperatures."

During A.S.T.M. Committee week, held from February 27 to March 3 last, more than 300 committees met in Pittsburgh and other cities to consider new specifications which will receive final endorsement at the Atlantic City Meeting.

On March 2, during Committee Week, a conference was held in Pittsburgh to determine the interest in the establishment of a separate A.S.T.M. Committee on the use of radioactive isotopes in testing. Chairman was Dr George G. Manov of the Atomic Energy Commission, Oakridge, Tennessee. Speaking of the applications of radioactive isotopes, Dr Manov mentioned radioactive piston rings for checking wear, friction studies, fluid flow through pipes and oil field drilling.

The conference was attended by pioneer industrial users of radioactive isotopes in such varied fields as corrosion, bleeding of bituminous materials, wetting agents and industrial waste disposal.

In view of the broad interest taken, the opinion of the Conference was that the Board of Directors should give consideration to the organization of a new committee on radioactive isotopes.

LAUNCHES FOR VENEZUELA

The first of six fast aluminium alloy launches, constructed and designed for use in Shell's operations on Lake Maracaibo, Venezuela, was recently completed and given trials at Shoreham-by-Sea, Sussex, when a speed of just over 18 knots was obtained.

Built by the Sussex Shipbuilding Co., the launch is engined by three 100-h.p. A.E.C. marine diesel engines on Silent Bloc mountings driving through 1.96:1 reduction gears.

Overall length of the launch is 53 ft, beam 13 ft and depth 3 ft 8 in. Twenty passengers can be seated in the forward cabin.

The remaining five launches are being built to exactly similar specifications and are expected to be completed during the next three months.

The new 53 ft-long aluminium alloy launch during trials at Shoreham-By-Sea, Sussex.

These launches will be used to carry drilling crews between the shore base and the rigs erected in Lake Maracaibo.

★ ★ ★

Neon Indicator Lamps. A leaflet describing the "Acru" range of neon indicator lamps has been produced by the Acru Electric Tool Manufacturing Co. Ltd., 123 Hyde Road, Ardwich, Manchester 12.

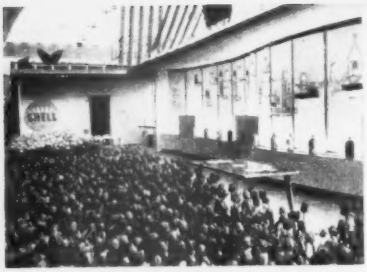
APPOINTMENTS VACANT

AN INTERNATIONAL OIL COMPANY with Head Office London requires **Sales Executive** for Karachi branch office. Age 25/30, single. Applicants should have engineering and preferably some sales experience. Initial training given in England. Excellent prospects, good salary, attractive leave arrangements, free passage out and home and free medical attention. Write, giving fullest details, to Box 1050, c/o Institute of Petroleum.

FUEL TECHNOLOGIST required for service with leading oil company in Australia. Age 30-40 years. Applicants should preferably be in possession of an Engineering Degree or Associate Membership of Institution of Mechanical Engineers or Heating and Ventilating Engineers, or Institute of Fuel or Petroleum, and must have practical experience of (a) coal to oil conversion of boilers, metal treatment melting furnaces, ceramic kilns, etc., or (b) the design of industrial heating plant, or (c) industrial heating research, or (d) as works fuel engineer. Commencing salary from £A.800 to £A.1000 according to age and experience. Provident Fund. If married free passage for wife and children. Successful candidate will be required to undergo a 3 month period of training in this country. Write, giving personal particulars and details of career, quoting Dept. F.197, to Box 2737 at 191, Gresham House, E.C.2.

ANGLO-AMERICAN OIL COMPANY LIMITED has vacancies on its Refinery Staff for **Junior and Senior** Technical personnel. Applicants for Junior posts should have preferably a First or Second Class Honours Degree in Chemistry or Chemical Engineering. Applicants for Senior posts should be graduates with experience in the petroleum or allied industries. Applications should be addressed to Refinery Superintendent, Anglo-American Oil Co. Ltd., Fawley, Hampshire, giving brief details of age, education, etc. Senior applicants should also give a summary of experience and state salary required.

PETROLEUM ENGINEERS required for Bahrein Petroleum Co. Ltd. (a) **Production,** with over five years experience in reservoir engineering research or in performance data for wells in the observation and use of depth pressures, etc.; (b) **Mud Engineering,** with over five years experience this type of work; (c) **General,** with over five years experience drilling and re-drilling and repair of producing wells; (d) with **Geological** qualifications additional to (c). Age limit 40. Free board, air conditioned quarters, and medical attention plus 10 per cent of salary for married employees during initial two years separation period. Low living costs, paid leaves. Write with full particulars age, experience, education, salary required to Box 3221, c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.



A beautiful bed of red and yellow tulips attracted attention to Shell's stand at the B.I.F. at Olympia. Main feature of the display was an animated flow chart showing stages in the manufacture of Teepol.

OIL INDUSTRY SUPPLEMENT

With its issue of April 22, 1950, the weekly journal *The Statist* has published a 24-page supplement on the oil industry. A foreword has been contributed by E. F. Richardson of Petroleum Information Bureau.

AIR PATROL FOR PIPELINES

Inspection of pipelines by aerial patrols is gaining in popularity in the United States. Nearly 100 planes and as many pilots are now engaged in spotting leaks. Aircraft tracking the pipelines skim along at altitudes varying from 200 to 500 ft at 100 m.p.h. or less. When a patch of oil is sighted the pilot flies to the nearest pumping station and drops a note giving location and estimated size of leak for the pumping station engineer. *The Lamp*, published by Standard Oil Co. (New Jersey), quotes an example of fast work from a report by a repair crew, which stated that the crew arrived at the location given by the pilot 18 minutes after the report was made.

★ ★ ★

Heat Insulation. William Kenyon and Sons Ltd., Dukinfield, Cheshire, have recently issued a leaflet showing some of the heat insulating work carried out by the firm in Britain and overseas.

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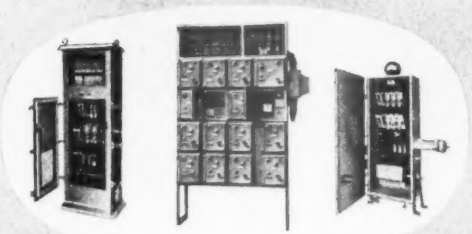

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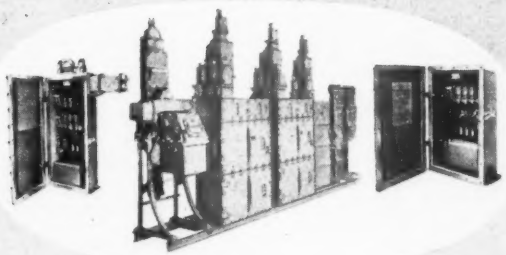

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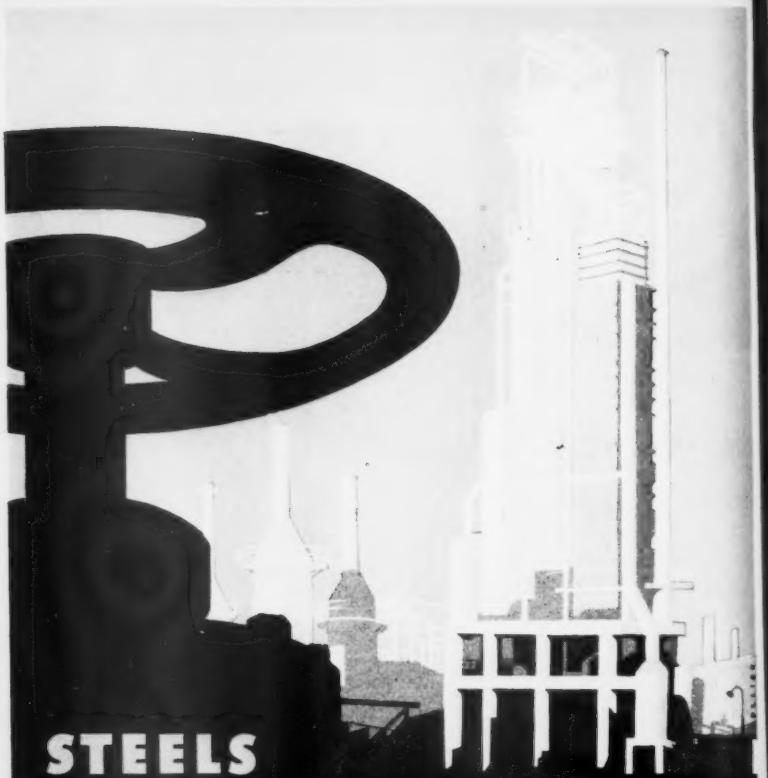

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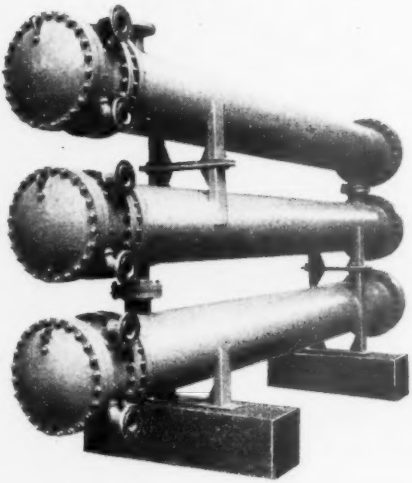

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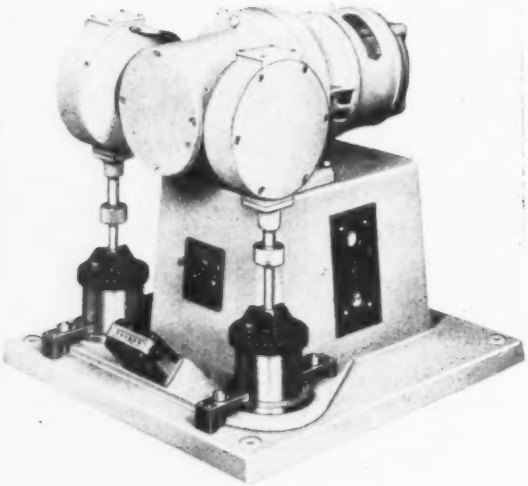

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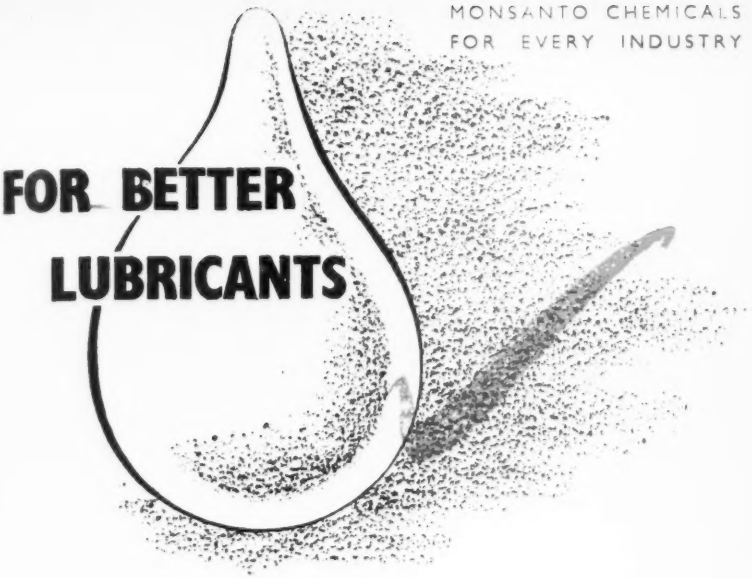

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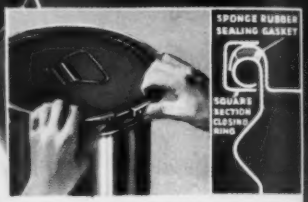

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